

Peritonitis from Starch Glove Powder

FRANK R. DUTRA, M.D., *Castro Valley* AND
C. DAVID JENSEN, M.D., *San Leandro*

■ *Contamination of surgical wounds by starch glove powders has produced peritoneal inflammation and adhesions in many patients. Some have required surgical operation because of possible infection, others because of obstruction of the intestine. Resolving granulomas and fibrosis have been observed as incidental asymptomatic lesions in some patients during reoperation for other conditions.*

Starch granules are probably capable of producing inflammation in any patient, and the degree is believed to be related to the amount of starch present.

Care in removing glove powder from gloves before they are worn in an operation will diminish or eliminate the problem. Removal can be accomplished by rubbing the gloves with a moist sterile towel or laparotomy tape.

POWDERED CORN STARCH, WHICH had recently been introduced as a lubricant for surgical gloves,^{1,2} was identified as a cause of granulomatous peritonitis in 1956.³ Subsequently, a few cases have been reported almost every year, but there has been no indication of numerous cases in all parts of the United States.

In 1970, we circulated a notice in several journals of pathology requesting data and tissue slides from such cases; furthermore, direct inquiry was made of two pathologists^{4,5} who had published brief abstracts of such cases. Communications were received from 37 pathologists, most of whom had from one to three cases; 15 were submitted by one pathologist and are included here, and 13 more accumulated by another pathologist are to be reported separately.

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Reprint requests to: F. R. Dutra, M.D., Director of Laboratories, Eden Hospital, 20103 Lake Chabot Road, Castro Valley, Ca. 94546.

*The following pathologists contributed information and tissue slides for this study (number of cases from each indicated in parentheses): RC Boylan MD (1), R Campbell MD (1), JK Duckworth MD (2), RE Fechner MD (1), C Robes MD (1), L Goodman MD (2), RC Harsch MD (2), HL Hoffman MD (1), CT Kelso MD (1), R Kleinhenz MD (1), WD Moore MD (3), C Moran MD (1), MJ Pophal MD (3), AC Pratt MD (1), H Standage MD (1), RE Swanson MD (3), CN Tschetter MD (3), EE Tueller MD (15), AS Ullman MD (1), JK Waken MD (1).

Information came from 15 states ranging from Maine to Hawaii and from Minnesota to Texas; data were adequate and tissue slides were available for study from 52 cases (including seven of our own), and these are the basis of this report.*

It has been possible to sharply define the clinical entity and to elucidate the evolution of the lesions over a long period. Tissues were obtained from patients as early as nine days and as late as four years after the introduction of starch into the peritoneal cavity. No other series has been so large, nor has the sequence of pathological changes from such early lesions to old completely fibrotic ones previously been reported.

Clinical Description:

All cases followed abdominal operation, with one exception. The latter occurred after vaginal examination during which the powder was presumably introduced through the uterine tubes, as described by other investigators.⁶

The ages of the patients varied from 22 to 78 years. There were 43 women and nine men, the

disparity reflecting in part the fact that a large proportion of abdominal operations are directed at the female genitalia; in this series, 22 of the 52 primary procedures were of this type. Gall-bladder operations were also frequent, and nine of the 14 cholecystectomy patients were women.

In general, there were two different patterns, both clinically and pathologically. There were 34 early cases, those in which symptoms occurred and a second operation was performed within two months after the introduction of starch into the peritoneal cavity. The remaining 18 late cases made up a second group, those from whom diagnostic tissue was obtained after two months or longer.

In early cases, the starch reaction began with abdominal pain (either focal or generalized), tenderness, fever, nausea, and vomiting. A few patients also had diarrhea. Leukocytosis was frequent during the first three weeks and one patient had pronounced eosinophilia. Differential diagnosis included appendicitis, cholecystitis, intra-abdominal abscess, and intestinal obstruction. The latter was the only preoperative diagnosis in 11 symptomatic patients who were operated on more than two months after the initial procedure.

Gross Pathology

At operation, the acute reaction included intra-peritoneal fluid, fibrin, and miliary granulomas. Liquid exudate, present in approximately half of the early cases, was often described as pale yellow and turbid; occasionally clear fluid was described. Amounts varied from 30 to 3,000 ml. Fibrinous exudate roughened the inflamed serosal areas, sometimes forming adhesions with adjacent surfaces. Often, the omentum was contracted into a boggy inflammatory mass.

Pale granulomatous nodules were present in nearly all, and were numerous and widespread in most, so that some surgeons erroneously identified the condition as tuberculous peritonitis or, less often, as carcinomatosis.

In the late cases, only scattered firm white nodules and dense fibrous adhesions remained. The miliary nodular structures were present in nine of eighteen of these late cases. Fibrous adhesions producing partial or complete intestinal obstruction were present in 11 of the 18, while adhesions in six others were incidentally ob-

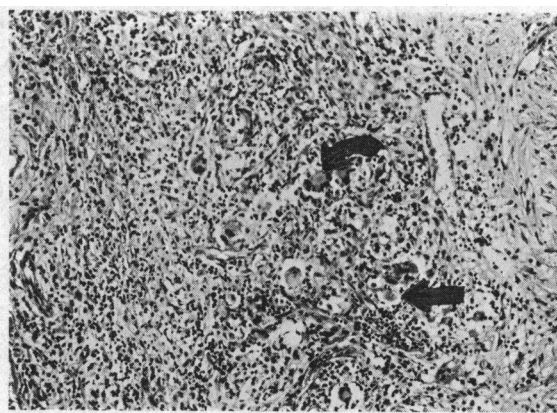


Figure 1.—Nodule from serosa of small intestine, 55 days after hysterectomy and surgical exploration of abdomen. Among the fibroblasts and large capillaries are numerous lymphocytes and phagocytes. Starch granule (straight arrow) and partially disintegrated starch granule (curved arrow) are in foreign body giant cells. (Hematoxylin and eosin, X 160)

served at autopsy or at operations for unrelated conditions.

Microscopic Pathology

Microscopically, the early lesions consisted of fibrin on the serosa, with fibroblasts and capillaries projecting into the fibrin. This was accompanied by stromal edema and infiltration by polymorphonuclear leukocytes (both neutrophilic and eosinophilic), lymphocytes, and phagocytic cells. Coalescence of phagocytes produced many multinucleated giant cells (Figure 1).

Up to about two months, eosinophils and lymphocytes were numerous, both diffusely and grouped around phagocytic cells. Spherical masses of the latter with central multinucleated giant cells formed many histologic tubercles. Some giant cells contained refractile pale basophilic granules, highly visible as Maltese crosses in the polarized light of Nicol prisms. These starch granules stained readily with iodine or PAS technique. In a few cases, iodine stains were negative while the PAS technique stained material in giant cells that was less sharply defined than typical starch granules. We believe this material is starch which has been partially hydrolyzed, and that it would soon disappear completely.

In late cases, the nodules consisted of necrotic centers surrounded by epithelioid cells in palisade arrangement, each with its dense collagenous envelope. Occasional Langhans giant cells

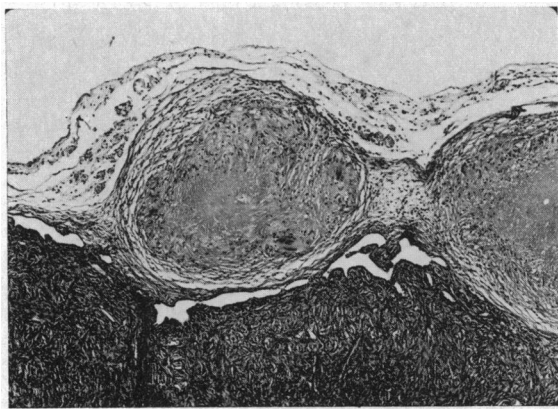


Figure 2.—Two of numerous firm white peritoneal nodules observed at hysterectomy for post menopausal vaginal bleeding five months after cholecystectomy and surgical exploration of abdomen. These were on the surface of a fibrotic ovary. Centers are necrotic and contain PAS-positive starch granules; epithelioid and giant cell zone is surrounded by loose connective tissue containing large capillaries. (Hematoxylin and eosin, X 100)

were in the palisade zone. Scattered granules of starch were within the necrotic material or the palisade layer (Figure 2). Nodular lesions of this type, 1 to 5 mm in diameter, were observed in delicate adhesions which also contained many large capillaries and hemosiderin granules.

Metaplastic mesothelial cells, cuboidal or spherical, were noted in many older cases. In some these cells formed groups between adjacent folds of omentum, and in one case they were so numerous and prominent as to suggest neoplasm.

Not infrequently, in patients who had had surgical operation several years previously, subserosal nodules of dense hyalinized collagen (focally calcified in one case) were found; we believe that these represent the end stage in the evolution of starch granulomas.

Other substances may induce reaction in the peritoneum and must be differentiated from starch. These include talc, gauze lint, suture material, and debris extruded from the digestive tract.⁷ Starch may be differentiated from all of these by its fairly uniform size and its reaction with iodine and PAS stains.

Discussion

The necessity of a dry powder lubricant for latex gloves led to the trial of lycopodium spores and later to talc. Within a few years it was recognized that inflammation and adhesions could follow deposition of these substances in the peri-

toneal cavity. Nevertheless, the use of talc was continued until a substitute lubricating powder, specially refined corn starch,* was described by Lee and Lehman¹ in 1947. Potassium bitartrate⁸ was also tested as a replacement for talc, but corn starch was adopted, and within a few years it had replaced talc in the operating rooms of "60 to 90 percent of hospitals in the United States."²

Lee and Lehman¹ stated in 1947 that their starch powder "is completely absorbed from the peritoneum without any demonstrated inflammatory reaction," and that "it produces no adhesions whatever." However, subsequent studies by Lee, Collins, and Largen² proved that a foreign body reaction does occur during the first three weeks after dispersion of powder into the peritoneal cavity. Clumps of powder prolong the reaction and may lead to fibrosis and adhesions. Lee et al² concluded: "Sterilizable corn starch approaches the theoretical ideal as a powder lubricant for gloves. Nevertheless, any powder, no matter how benign it may be or how quickly it is absorbed, produces some degree of foreign body reaction when it contaminates an open wound."

Three years later, in 1955, Sneierson and Woo⁹ reported the first complications ascribed to starch powder—two instances of incisional granulomas. Peritoneal reaction in two patients was described the following year³ and similar cases have been reported singly or in small groups almost every year since. The cases of peritoneal complications up to 1963 were tabulated by Bates,¹⁰ and she added a case of her own.

Between 1964 and 1966, a total of eight cases were the subjects of six papers, and in 1970, two groups of investigators^{11,12} described 11 more. Eight of these appeared in a period of six months and were ascribed to a change from corn starch to rice starch by one glove company. The authors¹² believed the rice starch cases to be more severe than the disease caused by corn starch.

It has been impossible to obtain information concerning the origin of the gloves in most of our cases. There is clear evidence that Bio-Sorb is the starch that has been responsible for the majority. We have no information indicating that rice starch was responsible for any of the cases reported here.

The most recent publication¹³ on the subject describes the pathologic changes in detail and

*Termed "#108," subsequently given the name "Bio-Sorb.®"

contributes clinical data on five additional cases of serosal disease caused by starch.

Individual idiosyncrasy has been suggested as an explanation of the sporadic occurrence of cases, an idea supported by the occasional case in which there is an eosinophilic leukocyte response. MacQuiddy and Tollmand¹⁴ did skin tests for starch sensitivity on 131 persons, 81 of whom "had allergic backgrounds," without positive results; attempts to elicit sensitivity reactions to parenteral injections in animals were also negative. On the other hand, in the case reported by Bates¹⁰ the patient had abdominal symptoms and a local skin reaction after intradermal injection of an extract of Bio-Sorb. In spite of this unique reaction, we believe that the tissue responses in nearly all cases are probably a direct reaction to the irritating material. The sporadic occurrence of cases may be the result of inadvertent excessive contamination or unusual clumping of the powder granules in these patients. Both experimental and clinical observations prove that these two factors can potentiate reactions, and that fibrous adhesions result from incomplete resolution in such cases.

We have occasionally observed starch granules in adhesions where their role as pathogenic agents would be doubtful. For example, a few particles and granulomas in dense adhesions following operation for a perforated diverticulum of the colon or for pelvic inflammatory disease may be of little or no importance as causative factors. Conversely, starch may not be found in some lesions it has produced; it can completely disappear from the tissues as the inflammation subsides, although fibrosis and adhesions persist.

We have had difficulty in recognizing starch with hematoxylin and eosin stains in some granulomas, while PAS technique or iodine reactions produced unequivocal positive results. Further examination of the hematoxylin and eosin sections revealed finely granular material, presumably partially decomposed starch, instead of the translucent blue granules which characterize fresh starch. This decomposition must occur irregularly, for it is noted in some cases of only a few weeks' duration while typical starch persisted in others for many months.

In early cases, surgical procedures were performed because of the possibility of abscess, appendicitis or intestinal obstruction. In late cases, operation was necessary because of adhesions

and intestinal obstruction. Some late lesions were incidental observations at operations for unrelated conditions or at autopsy. Biopsy was the only procedure at most second operations, but in some cases omentectomy and in a few cases cholecystectomy or resection of inflamed segments of intestine was carried out. Some patients who had persistent postoperative pain and fever received postoperative steroid therapy with satisfactory results.

Contamination of surgical specimens by starch is frequent. During microscopic examination of tissue sections, starch granules are often observed at the surfaces, and they may occur throughout the cellular and protein debris of "cell buttons" prepared from abdominal or thoracic fluids. Such contamination of a specimen during or subsequent to the operation at which it was removed should not be erroneously interpreted as a cause of preoperative illness. However, the presence of the granules does direct attention to the fact that starch contamination has not been eliminated, and additional cases of glove starch peritonitis may be anticipated.

In addition to peritoneal lesions, starch granules have been the cause of postoperative granulomas in a variety of wounds leading to abscesses and sinuses. Starch has also caused granulomas of the spermatic cord, paranasal sinuses, mastoid process and middle ear. Contamination of arteriography contrast media with starch granules has led to focal glomerulitis and to petechiae of the skin and retina.

Morbidity from starch peritonitis may be much more widespread than the paucity of reported cases would indicate. With few exceptions each contributing pathologist had more than one case, suggesting that identification of additional cases follows recognition of the entity.

We have also noted that some surgeons and surgical nurses are unaware of the problem, so that precautions to cleanse the gloves of excessive powder are not yet universally observed.

Recognition of the problem and application of appropriate surgical techniques should preclude introduction into wounds of significant amounts of starch. Attention to washing excess powder from the gloves has been advocated for years. However, an affinity seems to exist between starch granules and gloves, since merely withdrawing the hands after rinsing them in the

splash basin often leaves the gloves covered with powder granules and aggregates. Presumably this is caused by static electricity, but we find no published study of the phenomenon.

Punctured or torn gloves can yield contamination, including clumps of powder. That this may be a frequent source is suggested by a study some years ago⁸ which indicated that 22.6 percent of gloves are perforated during operations, permitting escape of powder from the finger tips.

Other uses of starch powder may lead to its introduction into tissues; rubber drains and tubes have powder on them and unless special efforts are made to remove it, the starch will be introduced into abdominal or other wounds.

Scrupulous cleansing of gloves has been accomplished by wiping them with a moistened cloth after they have been washed in the splash basin. Such cleansing must not be limited to the initial pair of gloves, but to any gloves that are changed during the course of an operation.¹⁵ The effectiveness of these procedures is indicated

by Sobel et al,¹³ who observed no further cases in a two-year period after these precautions were instituted.

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TENSION HEADACHE TREATMENT WITH ANTIDEPRESSANTS

Ninety percent of all the headaches we see (as general practitioners) are muscle contraction headaches. They are either anxiety or tension or depressive equivalents with conversion reactions. . . .

When you believe that you are dealing with a tension situation, you should do an inventory of the patient—an inventory of his marriage, his occupation, his life stresses, personality traits, habits, and methods of handling tension. Usually by doing a careful inventory you will work out the problems of the patient. Most of the people who come in to see me are not having a simple tension headache. Most of them are depressed. They are usually complaining of a constant daily headache, present all the time. There are certain key questions that we should ask. First, are the headaches relieved by the simple analgesics? They usually are not; aspirin does not relieve them. Then the most important question is about sleep habits. Does the patient have trouble going to sleep? Does he awaken frequently during the night? What time does he get up every morning? Most of these patients will give a history of generalized headache, frequent awakening, and early awakening every morning. You can treat these people with simple antidepressants—the tricyclic antidepressants. I don't care which one you use—amitriptyline, protriptyline, Tofranil®—any one of these will produce good results. You have to give the patient at least a week to ten days of treatment and tell him not to expect results for ten days. He is going to have a dry mouth; he is going to be a little sleepy at first; but after a while he is going to do well.

—SEYMOUR DIAMOND, M.D., Chicago
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